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(54) Drive device for rotating a machine tool table

(57) A drive device for rotating a machine tool table, the device having an armature (6), of a linear electric motor (4), located tangentially along the whole lateral surface of a circular table (2) and connected by its own lateral surface to the table; and an inductor (5), of the linear electric motor (4), located substantially facing at least part of the armature (6).

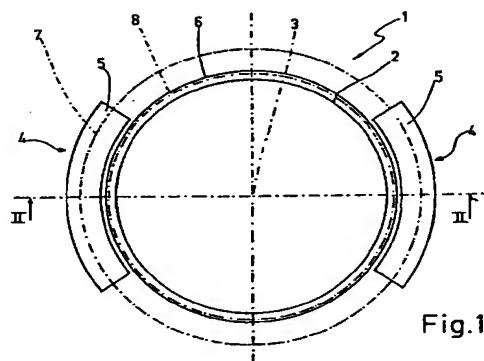


Fig.1

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Description

The present invention relates to a drive device for rotating a machine tool table.

The device according to the present invention may be used to advantage on punching machines, to which the following description refers purely by way of example.

As is known, in all fields of engineering, and particularly on machine tools, drive devices for producing rotation about an axis feature rotary electric motors, the shaft of which may be connected directly, or more often via a mechanical transmission, to the object being driven. For driving tables, in particular, requiring a high torque and low rotation speed, mechanical transmissions with a high reduction ratio (over 10) are normally used.

Using a drive comprising a rotary motor and mechanical transmission, however, presents several drawbacks. In particular, the mechanical transmission, by introducing position errors, impairs the control precision of the motor, and requires particularly high-cost routine maintenance, especially in terms of the downtime involved. Yet a further drawback is the amount of space required for the drive.

It is an object of the present invention to provide a drive device for rotating a machine tool table, designed to overcome the aforementioned drawbacks.

According to the present invention, there is provided a drive device for rotating a machine tool table, characterized by comprising an armature, of a linear electric motor, angularly integral with said table and located along at least a portion of a first circumference centered about the axis of rotation of the table; and characterized by comprising an inductor, of said linear electric motor, substantially facing the armature along at least a portion of a second circumference centered about the axis of rotation of the table.

A number of preferred, non-limiting embodiments of the present invention will be described by way of example with reference to the accompanying drawings, in which:

Figure 1 shows a top plan view of a first preferred embodiment of the device according to the present invention;

Figure 2 shows a section along line II-II in Figure 1; Figure 3 shows a top plan view of a second preferred embodiment of the device according to the present invention;

Figure 4 shows a section along line IV-IV in Figure 3;

Figure 5 shows a top plan view of a third preferred embodiment of the device according to the present invention;

Figure 6 shows a bottom plan view of the Figure 5 device;

Figure 7 shows a section along line VII-VII in Figure 5;

Figure 8 shows a top plan view of a machine tool featuring the device according to the present invention;

Figure 9 shows a section along line IX-IX in Figure 8.

Number 1 in Figure 1 indicates a drive device for rotating a circular horizontal table 2 about a vertical axis 3. Drive device 1 comprises a linear electric motor 4, in turn comprising an inductor or primary 5 and an armature or secondary 6; armature 6 is angularly integral with table 2 and located along at least a portion of a circumference 8 centered about axis 3; and inductor 5 is located facing armature 6 along at least a portion of a circumference 7 centered about axis 3.

Inductor 5 may face armature 6 internally or externally, i.e. the diameter of circumference 7 may be respectively smaller or greater than circumference 8.

As shown in Figures 1 and 3, table 2 may have a cylindrical outer periphery surrounded by armature 6, and to which the inner lateral surface of the armature is connected; or, as shown in Figures 5 and 6, armature 6 may be connected by its upper surface to the bottom of table 2; or (not shown), armature 6 may be connected by its bottom surface to the top of table 2.

The angles covered by inductor 5 and armature 6 depend on different requirements. The angle covered by inductor 5 depends on the drive torque required - the greater the drive torque, the greater the angle covered by inductor 5 - but must be substantially no greater than the angle covered by armature 6, in that any portion of inductor 5 not facing a corresponding portion of armature 6 produces substantially no drive torque. The angle covered by armature 6, on the other hand, depends on the amount of rotation required, in that, to avoid a drastic reduction in drive torque, inductor 5 must face a corresponding portion of armature 6 throughout the movement of table 2. That is, for table 2 to make a complete turn, armature 6 must cover an angle of 360°.

Linear electric motor 4 may be of various known types, e.g. a synchronous, asynchronous, direct-current or step motor. For machine tools, synchronous or asynchronous linear electric motors are more advantageous. In the case of drives not requiring a particularly high drive torque, use is conveniently made of asynchronous motors in which armature 6 is defined by a portion of the table itself. That is, as opposed to being formed separately and fixed to table 2, armature 6 is formed directly on table 2, thus obviously saving on material. In this case, a squirrel cage may be formed on table 2, or, in the case of low drive torques, table 2 may simply be used as it is with no special alterations. This type of armature 6 may, of course, only be formed if table 2 is made of steel or other material with good magnetic characteristics.

Figure 8 shows an example of drive device 1 according to the present invention, as applied to a punching machine 9 comprising two circular horizontal tables - a top table 2a and bottom table 2b - rotating

about a vertical axis 3. Table 2a supports a number of punches 10 arranged along a circumference 13 centered about axis 3, and table 2b supports a number of dies corresponding to and arranged similarly to punches 10. Machine 9 also comprises a hammer 12 moved up and down by actuating means 14, and for operating punches 10 at a predetermined work station 15; and actuating means 16 for feeding a metal work sheet 17 horizontally on to machine 9. Tables 2a and 2b are rotated respectively by drive devices 1a and 1b, each comprising an inductor 5, and an armature 6 connected tangentially by its lateral surface to the whole of the lateral surface of table 2.

Operation of drive device 1 is quite straightforward. When supplied, inductor 5 of linear electric motor 4 generates on armature 6 a force directed tangentially with respect to the armature; and, as armature 6 is angularly integral with table 2 and located along a portion of a circumference 8 centered about the axis of rotation 3 of table 2, said force results in a drive torque for rotating table 2.

The device according to the present invention affords numerous advantages by featuring no mechanical transmission of any sort, the driving force being generated in a part of the motor, i.e. the armature, connected directly to the table being driven. Control of the motor is extremely precise by eliminating any position errors introduced by transmission components. No maintenance is required, by virtue of the drive involving no mechanical contact. And, finally, the drive so formed is considerably more compact as compared with traditional types.

Clearly, changes may be made to device 1 as described and illustrated herein without, however, departing from the scope of the present invention.

Claims

1. A drive device for rotating a machine tool table, the table (2) being mounted for rotation about an axis (3) of rotation perpendicular to the table; characterized by comprising a linear electric motor (4) in turn comprising an armature (6) angularly integral with said table (2) and located along at least a portion of a first circumference (8) centered about the axis (3) of rotation of the table (2); the linear electric motor (4) also comprising an inductor (5) substantially facing the armature (6) along at least a portion of a second circumference (7) centered about the axis (3) of rotation of the table (2).
2. A device as claimed in Claim 1, characterized in that said first circumference (8) is smaller in diameter than said second circumference (7).
3. A device as claimed in Claim 1, characterized in that said first circumference (8) is larger in diameter than said second circumference (7).

4. A device as claimed in Claim 2, characterized in that said table (2) has a cylindrical outer periphery; said armature (6) surrounding at least part of said outer periphery, and being connected by an inner lateral surface to the table (2).

5. A device as claimed in any one of the foregoing Claims from 1 to 3, characterized in that said armature (6) is located underneath the table (2), and is connected by an upper surface to the table.

6. A device as claimed in any one of the foregoing Claims from 1 to 3, characterized in that said armature (6) is located on top of the table (2), and is connected by a bottom surface to the table.

7. A device as claimed in any one of the foregoing Claims, characterized in that said linear electric motor (4) is a synchronous linear electric motor.

8. A device as claimed in any one of the foregoing Claims from 1 to 6, characterized in that said linear electric motor (4) is an asynchronous linear electric motor.

9. A device as claimed in Claim 8, characterized in that said armature (6) is defined by a portion of said table (2).

10. A drive device for rotating a machine tool table, substantially as described with reference to the accompanying drawings.

11. A machine tool, characterized by comprising at least one rotary table (2) powered by a drive device (1) as claimed in any one of the foregoing Claims.

12. A machine as claimed in Claim 11, characterized by being a punching machine (9) comprising two circular, horizontal said tables (2a, 2b) rotating about a vertical axis (3); a first (2a) of said tables (2a, 2b) supporting at least one punch (10), and a second (2b) of said tables (2a, 2b) supporting at least one die (11) corresponding with said punch (10); the punching machine (9) also comprising a hammer (12) for operating the punch (10) at a predetermined work station (15).

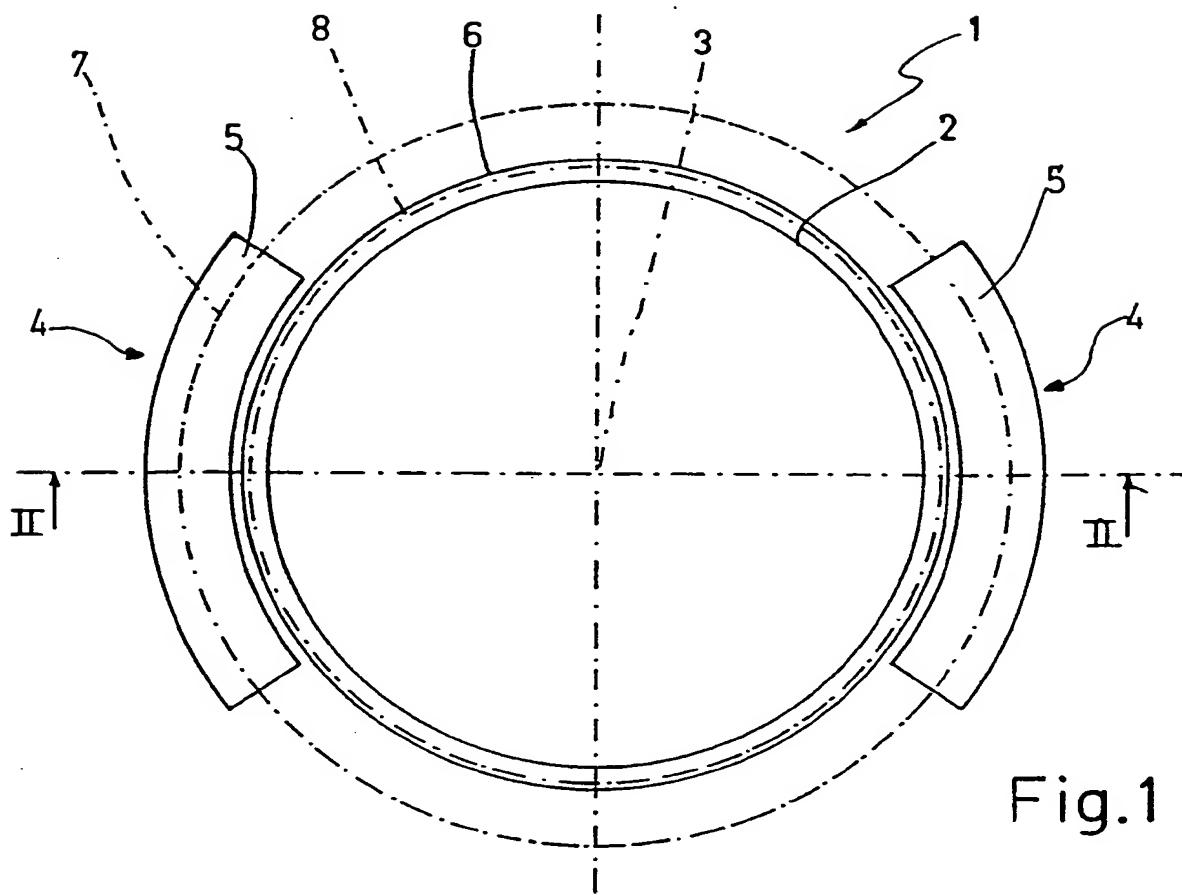


Fig.1

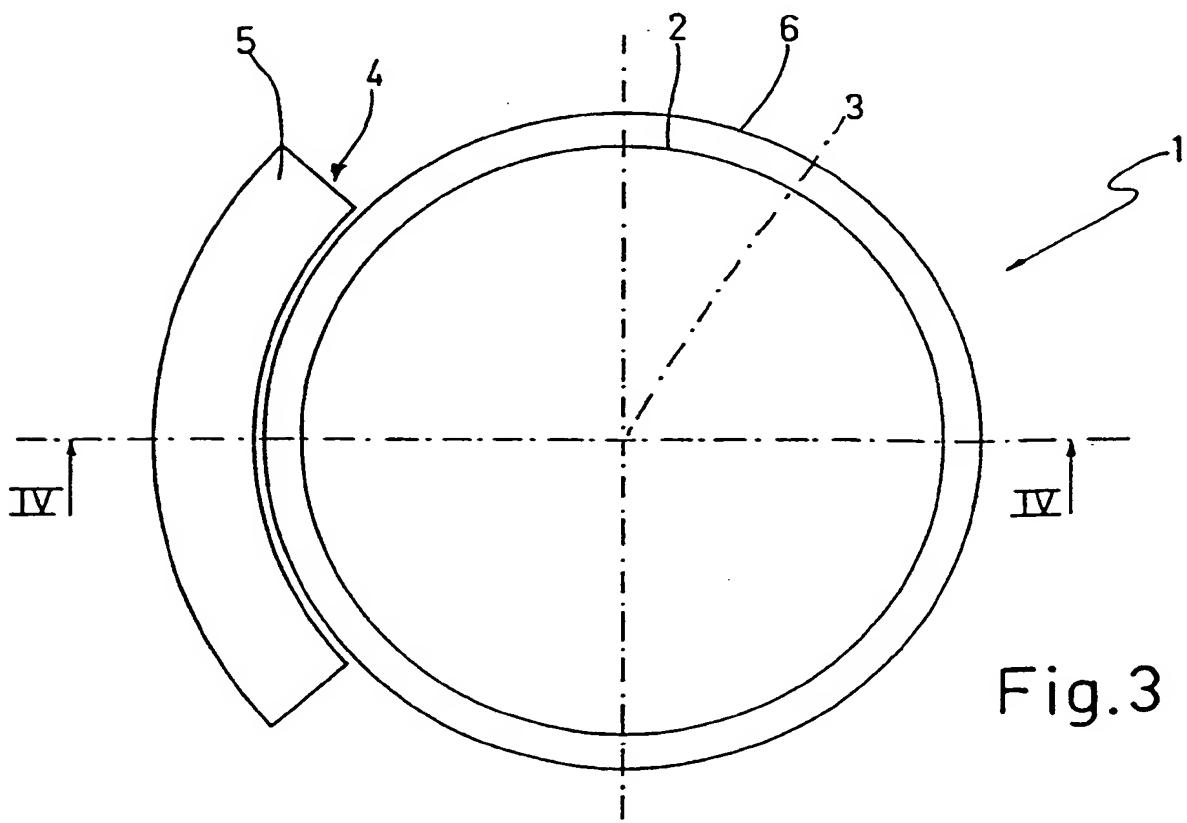


Fig.3

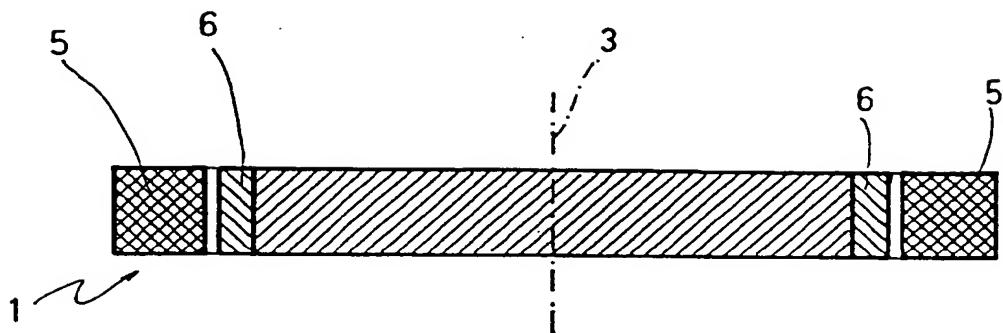


Fig.2

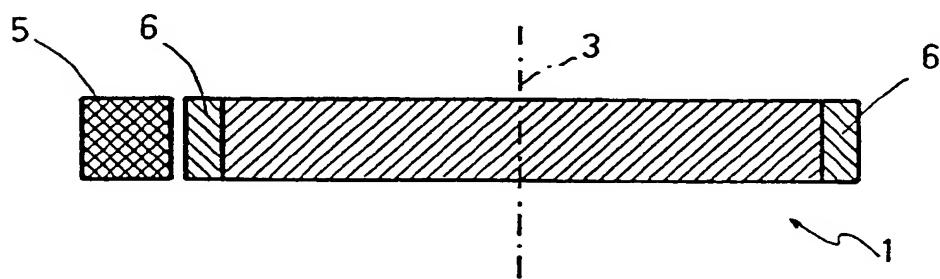


Fig.4

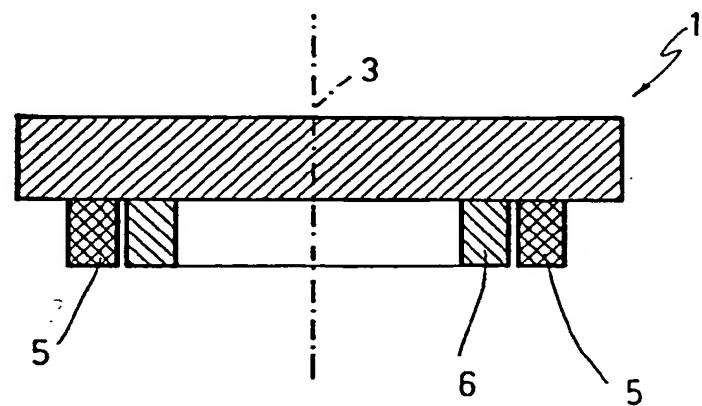


Fig.7

Fig.5

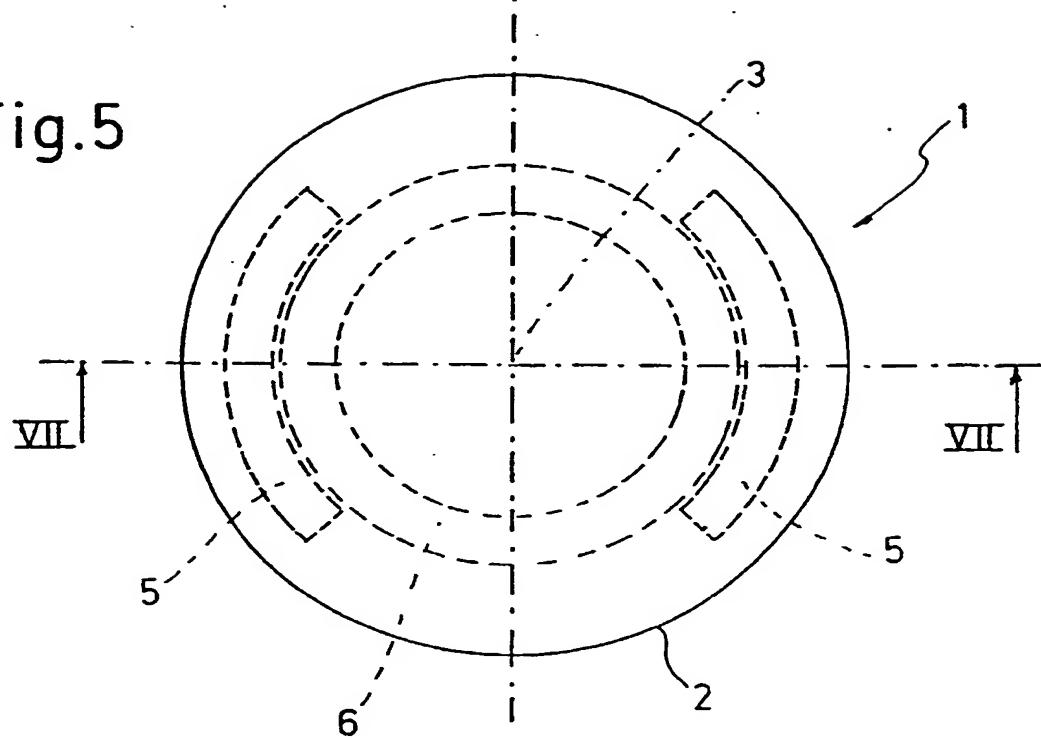
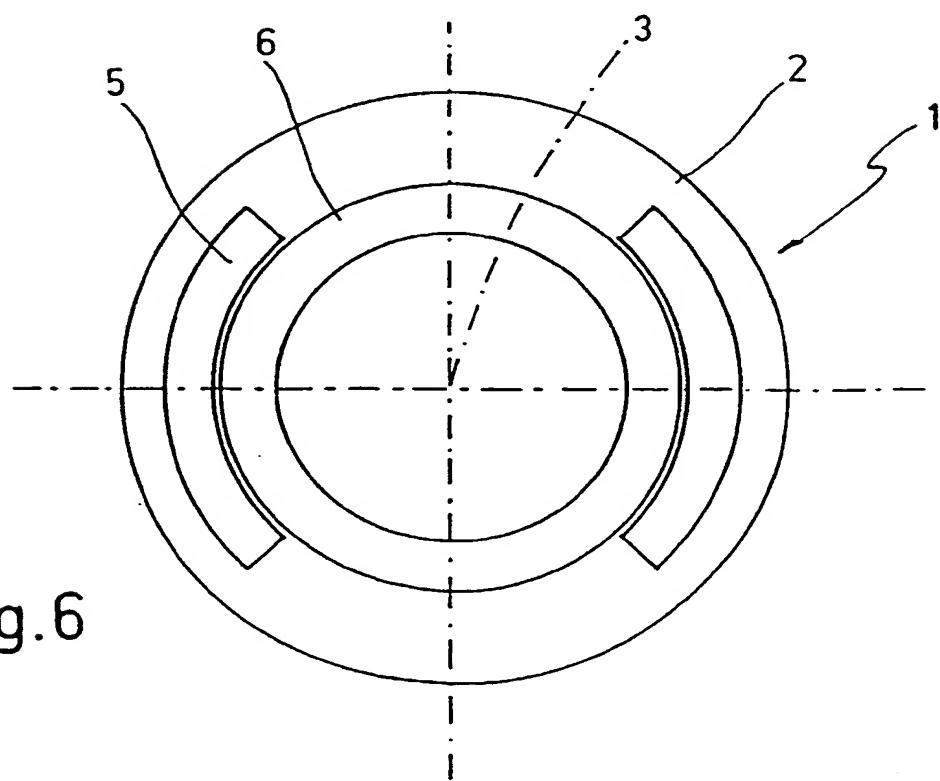
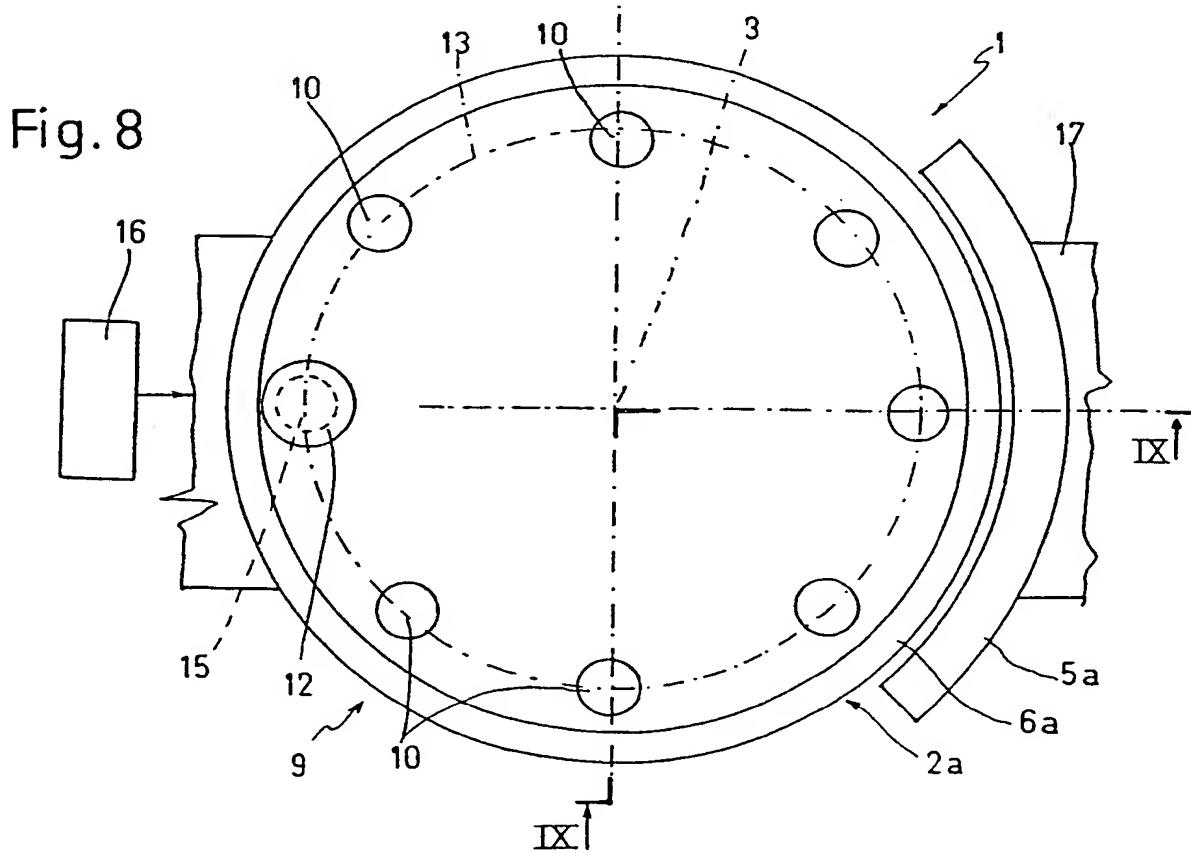
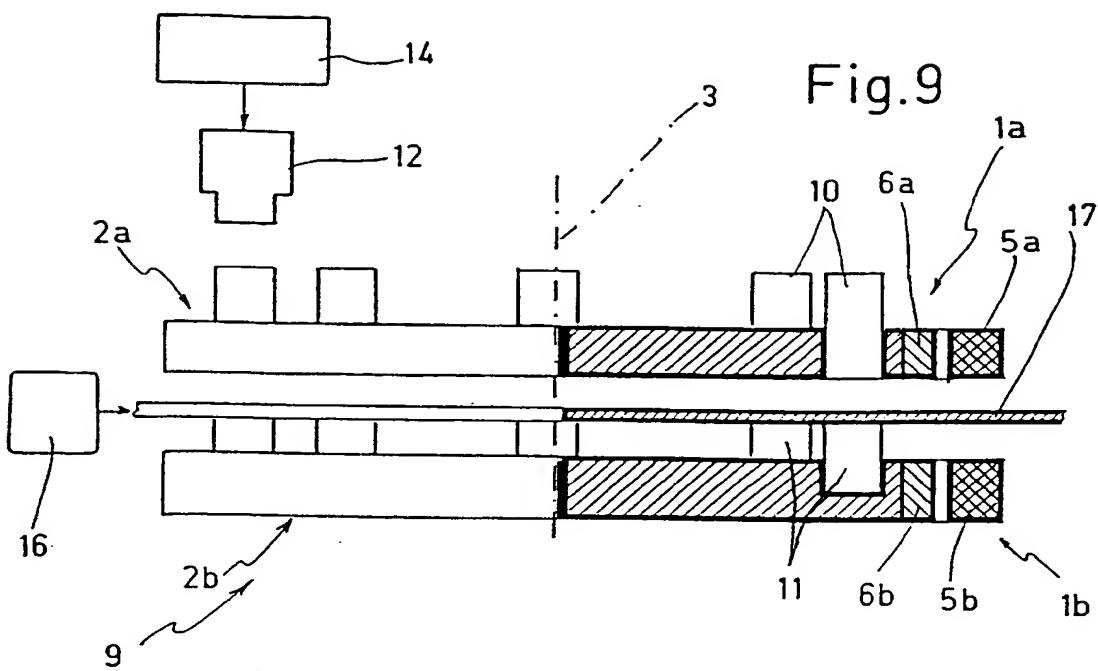


Fig.6





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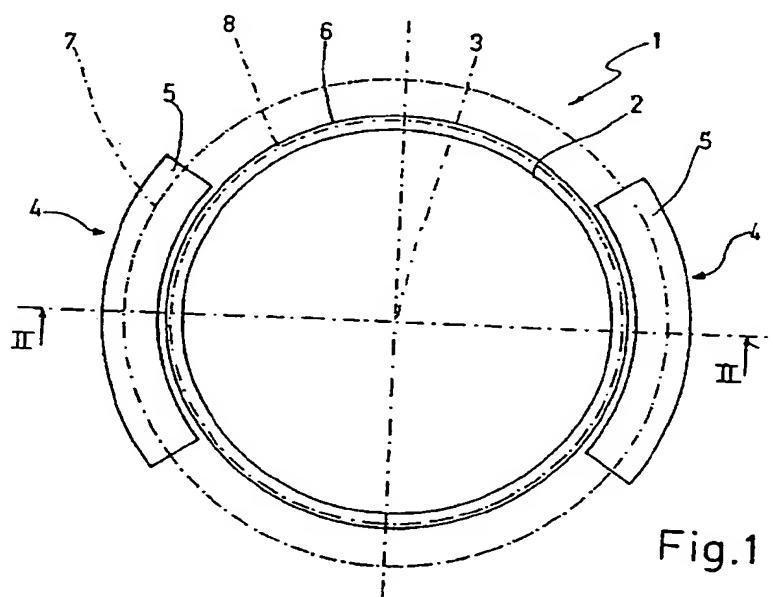


Fig.1

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EUROPEAN SEARCH REPORT

Application Number

EP 97 10 4708

DOCUMENTS CONSIDERED TO BE RELEVANT			CLASSIFICATION OF THE APPLICATION (Int.CL6)						
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim							
X	PATENT ABSTRACTS OF JAPAN vol. 013, no. 415 (M-870), 13 September 1989 & JP 01 153244 A (NISSAN MOTOR CO LTD), 15 June 1989, * abstract *	1-11	B23Q5/28 B23Q1/25						
X	PATENT ABSTRACTS OF JAPAN vol. 009, no. 179 (M-399), 24 July 1985 & JP 60 048245 A (HITACHI KINZOKU KK), 15 March 1985, * abstract *	1							
X	FR 2 439 502 A (ELEKTROMAT VEB) 16 May 1980 * figures 1,2 *	1							
A	GB 1 482 261 A (IDEAL TUBES LTD) 10 August 1977								
A	FR 2 233 674 A (HUMBERT JACQUES) 10 January 1975		TECHNICAL FIELDS SEARCHED (Int.CL6) B23Q						
<p>The present search report has been drawn up for all claims</p> <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 33%;">Place of search</td> <td style="width: 33%;">Date of completion of the search</td> <td style="width: 33%;">Examiner</td> </tr> <tr> <td>BERLIN</td> <td>2 July 1997</td> <td>Korth, C-F</td> </tr> </table>				Place of search	Date of completion of the search	Examiner	BERLIN	2 July 1997	Korth, C-F
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<p>CATEGORY OF CITED DOCUMENTS</p> <p>X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document</p> <p>T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document</p>									